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Rediscovery and redescription of *Sphenomorphus beyeri* Taylor (Reptilia: Lacertilia: Scincidae) from the Zambales Mountains of Luzon, Philippines

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Abstract.—*Sphenomorphus beyeri* Taylor, 1922, long known from a single specimen, is redescribed on the basis of newly acquired material from the herpetologically unsurveyed area of the Zambales Mountains, west central Luzon Island, Republic of the Philippines. Phenotypically most similar to its distantly allopatric congener *S. diwata,* the holotype and our new series are distinguished from other Philippine *Sphenomorphus* by the combination of their small to moderate size (SVL = 46.6–67.1 mm), fused frontoparietals, 88–96 paravertebrals, 38–42 scales at midbody, 19–21 subdigital fourth toe lamellae, and unique coloration.

In his monograph on the lizards of the Philippine Islands, E. H. Taylor (1922a) recognized 16 Philippine species in the genus *Sphenomorphus* (Lacertilia: Scincidae). He later supplemented this work on Philippine lizards with descriptions of two more scincid species in a more general herpetological contribution (Taylor 1922b). One of these was *Sphenomorphus beyeri,* a skink described on the basis of a single specimen found on Mt. Banahao in the Laguna Province of southern Luzon. Brown & Alcala (1980) later recognized 22 species of Philippine *Sphenomorphus.* One of these was *S. diwata* Brown & Rabor (1967), which the authors hypothesized to be the closest relative of *S. beyeri.* Brown & Alcala reported *S. diwata* from the Diwata mountains of northern Mindanao Island, and placed it and *S. beyeri* into the two-species non-phylogenetic couplet "Group I *Sphenomorphus*" (1980:154). As presently understood, the genus *Sphenomorphus* contains over 120 species world-wide (Myers & Donnelly 1991) with 60 species in the Oriental and Australian zoogeographic regions alone (Brown & Alcala 1956, 1961a; Greer & Parker 1974; Greer 1979).

Sphenomorphus beyeri has, to date, only been known from the incomplete holotype, yet it invariably has been recognized as a valid species. In the course of a recent inventory of the fauna of the Philippines undertaken by the Cincinnati Museum of Natural History (CMNH) and the National Museum of the Philippines (PNM), we captured 16 additional specimens of *S. beyeri* in the mossy cloud forests of the Zambales Mountains of west central Luzon. Collection of this new material provided us with a unique opportunity to analyze intraspecific morphological variation of this endemic Philippine skink and to reconsider the validity of its specific rank.

Methods

We conducted field studies in the Zambales Mountain range from 17 February to 18 March 1992. Drift fences and pitfall traps (25 m of 0.65 ml black plastic, stretched to 15 cm above ground, supported with wooden stakes, with ≥50 cm deep plastic-lined pits spaced every 5 m for a total of six pitfalls per 25 m of drift fence at each 100 m interval on slope) and time-constrained searches were used to collect specimens. Specimens were photographed, then fixed in 10% buffered formalin; notes on coloration, behavior, and habitat (including elevation) were recorded at time of capture. Upon return to the U.S.A. (approximately one month later), specimens were transferred to 70% ethanol.

Detailed examination of all material was conducted at the Cincinnati Museum of Natural History and at the National Museum of Natural History. When possible (see character definitions below), we took measurements and scale counts following techniques detailed in Brown & Alcala (1980); illustrations of head scalation were made (by RMB) with a Wild microscope equipped with a camera lucida attachment.

Characters (measured to the nearest 0.1 mm) are defined as: snout-to-vent length (SVL), from tip of animal's snout to caudal margin of anal scale; tail length (TL), from caudal margin of anal scale to tail's tip (specimens with regenerated tails are not included in statistical analyses); axilla-groin distance (AGD), from caudalmost point where forelimb meets body to anteriormost point where hind limb meets body; hind leg length (HLL), from point where rear limb meets body to tip of longest (=4th) toe; head length (HL), from tip of snout to caudal edge of tympanum; head breadth (HB), width of head at its widest point (=ocular region) when viewed from above; snout length (SL), from anterior edge of bony orbit to tip of snout; eye diameter (ED), horizontal diameter across bony orbit; and tympanum diameter (TD), horizontal distance across the tympanic annulus.

Lateral head scales (e.g., labial scales) were examined on both sides of the head and numbers for each side are given separately with a dashed line (—) designating left from right respectively. Meristic and mensural data are given as means ± standard deviations (*SD*) and range.

Statistical analyses were carried out using the Statistical Analysis Software Program (SAS), version 6.03 (SAS Institute Inc. 1988a, 1988b), using UNIVARIATE procedure for standard statistics. Significance of moment statistics (skewness, g_1, and kurtosis, g_2) was calculated by hand (Sokal & Rohlf 1981:174–175).

Specimens are deposited in the California Academy of Science (CAS), Cincinnati Museum of Natural History (CMNH), and National Museum of the Philippines (PNM). Material Examined includes: Holotype (Luzon Island, Laguna Province, Mt. Banahao) CAS 61183, immature male, collected on a rock ledge on Mt. Banahao at 1500 m by E. H. Taylor (Taylor 1922b:285). Six females (CMNH 3652, 3653, and 3658; PNM 2307, 2301, and 2304), nine males (CMNH 3655, 3657, and 3659; PNM 2300, 2302, 2303, 2305, 2306; USNM 337768) and one immature juvenile or hatchling (CMNH 3654), all collected by RMB and JWF. All were taken from Luzon Island, Zambales Province, Municipality of Masinloc, Barangay of Coto, Zambales Mountain range, Mt. High Peak.

Study Sites

Until the present study, (PNM/CMNH Philippine Biodiversity Inventory) the Zambales Mountains (Zambales Province, Municipality of Masinloc) were completely unsurveyed herpetologically due to a combination of major insurgency in this area and its close proximity to the Subic Bay Naval Base, 70 km south in the town of Olongapo. Following the eruption of Mt. Pinatubo in 1991 and subsequent closing of

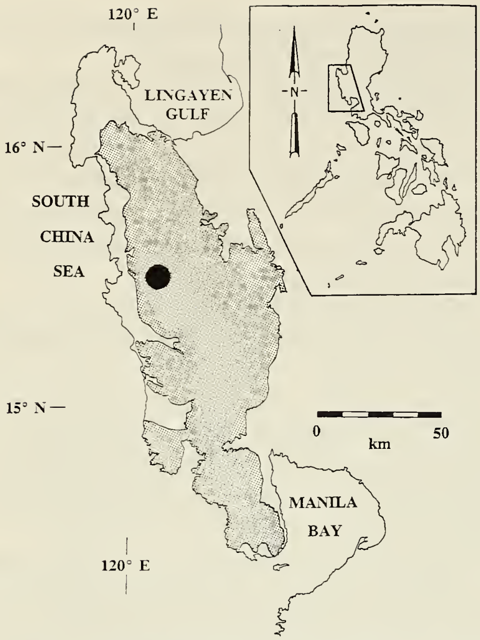

Fig. 1. The Zambales Mountains. Shaded area represents the major geologic formation constituting the Zambales Mountain range (see text). Darkened circle represents Mt. High Peak, and encompasses both localities sampled.

the United States military facilities at Olongapo, an opportunity was made available to naturalists to survey this largely unknown region.

The Zambales Mountains (Fig. 1) are an isolated coastal mountain range encompassing an area of approximately 6960 km² on west central Luzon; the Zambales range extends from west of the Lingayen gulf to the western border of Manila Bay at an orientation of 20° West of due North. To the east, the Zambales Mountains are isolated from the nearest mountain range, the Cordillera Central, by the Plains of Tarlac (also known as the Pampanga Plains). To the west and north, these mountains end in the South China Sea; to the south they separate Subic Bay from Manila Bay. The Zambales Mountain range currently is contiguous with mainland Luzon, connected to the latter by the wide Plains of Tarlac, believed to have been submerged below the Luzon sea during the Pliocene and Pleistocene (Rutland 1968; Hashimoto 1981a, 1981b; Auffenberg 1988). Geological evidence suggests that the Zambales Mountains were formerly isolated much farther west of their present position and were surrounded by water—not connected to mainland Luzon as they are today (Dickerson 1924, Auffenberg 1988). The Zambales currently represent a large "insular" massif, geologically isolated from the three other principal montane regions of Luzon (Bureau of Mines 1963; UNESCO/ECAFE 1971; Hashimoto 1981a, 1981b; Auffenberg 1988).

Site 1.—Zambales Mountains, 1100 m, 15°35'N, 120°09'W. Sampled from 17 to 26 February, the site is a tropical moist deciduous forest type (Whitmore 1984); virgin timber (predominantly Myrtaceae, Lauraceae, and Tiliaceae) begins at an elevation of ca. 1030 m. Presence of Mt. Pinatubo ash deposits throughout the area combined with noticeable signs of rattan gathering efforts undertaken by local residents precludes designation of the area as "undisturbed."

Site 2.—(Fig. 2) Zambales Mountains, 1500 m., 15°30'N, 120°08'W. Sampled between 11 and 18 March 1992, this area lies within the broad category of tropical moist deciduous forest type but remains, nonetheless, more typical of the upper montane (="mossy") rain forest (Whitmore 1984) due, presumably, to its somewhat higher elevation. Virgin timber predominates (Fagaceae, Myrtaceae, Magnoliaceae, and Pinaceae) and very little bamboo or other secondary or disturbance indicator species were encountered.

A more extensive description of these study sites and a discussion of their geologic importance is provided by Ruedas et al. (1994).

Results

Capture data.—A single specimen of *S. beyeri* collected at Site 1 was a mature male

Fig. 2. Typical habitat of *S. beyeri* between 1500 and 1600 m on Mt. High Peak, Zambales Mountains where most specimens of *Sphenomorphus beyeri* were found. The vegetation and forest floor in this area were coated with approximately 2–4 cm of volcanic ash from the eruption of Mt. Pinatubo. Photo from a color transparency by RMB, courtesy of CMNH.

(PNM 2300) collected under leaf litter on the forest floor at 1265 m. When disturbed, this lizard became alert, moved in a rapid serpentine manner and attempted to burrow under debris and leaf litter. A pair of pitfall trapped specimens (CMNH 3652, a gravid female; PNM 2301, a mature female without eggs) from Site 2 were captured during the day, at 1510 m, and 1610 m, respectively. The rest of the new series was captured by splitting open rotten logs lying horizontally in contact with the forest floor. One specimen (male, PNM 2305) was damaged when the machete used to split the log struck it. No specimens were taken at night despite extensive search efforts.

Sphenomorphus beyeri Taylor, 1922:283
Fig. 3, 4

Diagnosis.—A small to moderate-sized *Sphenomorphus, S. beyeri* is readily distinguished from its congeners by the following combination of characters: (1) prefrontals moderate, usually separate; (2) frontoparietals fused except in immature specimens; (3) usually 6–7 labials; (4) four large supraoculars (5) paravertebrals 88–96; (6) scales around midbody 38–42; (7) fourth toe lamellae 19–21; (8) body proportion ratios as follows, SL/HL = 0.25–0.37; SL/HB = 0.38–0.57; HB/HL = 0.60–0.69; HB/SVL = 0.13–0.17; ED/SL = 0.30–0.43; (9) unique coloration and color pattern.

Description (based on holotype and 16 referred specimens).—Details of the head scalation of an adult male (PNM 2302; captured by RMB on 16 March 1992 in montane cloud forest at 1460 m, between 1400 and 1630 hr) are shown in Fig. 3 from dorsal (A), ventral (B) and lateral (C) perspectives.

Head scalation.— Rostral 1.2–2.9 ($\bar{X}$ = 2.2 ± 0.4 *SD*, n = 14) mm wide (holotype

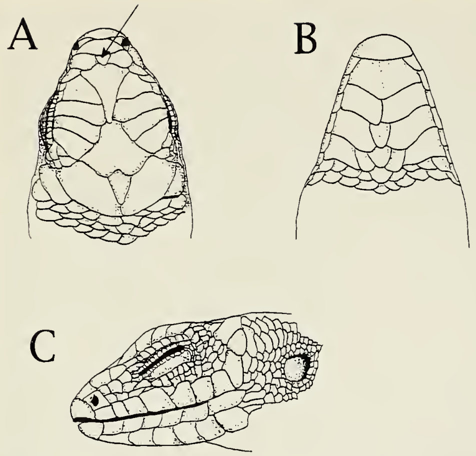

Fig. 3. Dorsal (A), ventral (B), and lateral (C) perspectives of head scalation of *Sphenomorphus beyeri* (PNM male 2302; HL = 12.0 mm). Arrow indicates the presence of the azygous interprefrontal scale on snout.

= 1.8). Frontonasals 1.7–2.4 ($\bar{X}$ = 2.2 ± 0.3 *SD, n* = 14) mm wide and 1.1–1.6 ($\bar{X}$ = 1.3 ± 0.2 *SD*; *n* = 14) mm long (holotype = 1.9 × 1.1). Ten of 17 specimens (including holotype) with separate prefrontals, four specimens with prefrontals in narrow to moderate contact, and three with prefrontals separated by an azygous interprefrontal (Fig. 3). Interprefrontals wider anteriorly; their caudal tip projecting slightly beyond prefrontal/frontal suture.

Frontal triangular, longer than wide, narrowed to a point caudally; in contact with two anterior supraoculars; length 2.8–3.7 mm ($\bar{X}$ = 3.3 ± 0.4 *SD, n* = 14) width 1.7–2.5 mm ($\bar{X}$ = 2.0 ± 0.4 *SD, n* = 14) (holotype = 3.1 × 1.9). Frontoparietals fused; 2.3–3.4 mm ($\bar{X}$ = 2.8 ± 0.4 *SD, n* = 14) long and 2.5–4.3 mm ($\bar{X}$ = 3.5 ± 0.4 *SD, n* = 14) wide (holotype = 2.7 × 3.2). Parietals behind interparietal in contact for a distance shorter than the parietal itself. Interparietals 1.5–2.8 mm ($\bar{X}$ = 1.9 ± 0.5 *SD, n* = 14) long and 1.2–1.6 mm ($\bar{X}$ = 1.3 ± 0.2 *SD, n* = 14) wide (holotype = 1.7 × 1.3).

Nasal large and single with nostril at center, bordered posteriorly by two pairs of overlapping (superimposed) loreals; most dorsal larger than ventral. Holotype with only 10 supraciliaries; supraciliaries varying considerably among and between our series of specimens: 11—12 (two specimens), 12—11 (1), 13—11 (1), 12—12 (2), 12—13 (2), 13—12 (2), 13—13 (3), 13—14 (1), 14—13 (1), and 14—14 (1); $\bar{X}$ = 12.6—12.5 ± 0.9—0.9 SD; range = 11–14—11–14; *n* = 16—16. All specimens with four large supraoculars; anterior most strongly triangular; the second widest. Caudalmost supraocular followed by three or four curved rows of very small scales, each with two or three scales. Tympanum exposed, not strongly depressed or sunken. Holotype with 6—7 upper labials and 6—6 lower labials. Our series varies considerably in both upper and lower labial scale counts: Upper labials: 6—5 (one specimen), 6—6 (10), 7—7 (4) or 7—6 (1); $\bar{X}$ = 6.3—6.6 ± 0.5—1.1 *SD*; range = 6–7—5–7; *n* = 16—16. Lower labials: 5—5 (1), 5—6 (1), 6—6 (12), 6—8 (1), 7—7 (1), or 8—7 (1); $\bar{X}$ = 6.3—6.4 ± 1.0—1.5 *SD*; range = 5–8—5–8; *n* = 16—16. Mental chin scale 2.3–3.4 mm ($\bar{X}$ = 2.8 ± 0.3 *SD, n* = 14) wide and 1.5–2.4 mm ($\bar{X}$ = 1.9 ± 0.3 *SD, n* = 14) long (holotype = 2.6 × 1.6); followed by one postmental, the latter in contact with two lower labials.

Dorsal scalation.—Nuchal scales undifferentiated. Scales (transversely) around midbody = 38 (two specimens), 39 (6), 40 (5, including holotype), 41 (1), and 42 (2); $\bar{X}$ = 39.9 ± 1.17 *SD, n* = 16. Paravertebrals = 88 (one specimen), 89 (2), 90 (2), 91 (2), 92 (6), 93 (1), 94 (holotype), and 96 (2); $\bar{X}$ = 91.5 ± 2.37 *SD, n* = 16.

Subdigital lamellae and ventral scalation.—All specimens with long digits, as reflected in lamellae scale counts. Both the holotype and our specimens display a longest to shortest toes rank of 4, 3, 2, 5, 1. Holotype has 19—19 fourth toe lamellae, whereas our series with 19—19 (two specimens), 19—20 (1), 20—20 (5), or 21—21 (8); $\bar{X}$ = 20.3—20.4 ± 0.8—0.7 *SD*; range

Table 1.—Measurements (in mm) from all known specimens of *Sphenomorphus beyeri* (character abbreviations in text). Standard univariate statistics, presented below, are abbreviated as follows: $\bar{X}$, mean; *SD*, standard deviation; *W*, Shapiro-Wilk test for normality (N = normal); g_1 = skewness statistic; g_2 = kurtosis statistic. None of the skewness or kurtosis statistics were found to be significant ($P > 0.05$). CMNH 3654 and the holotype were excluded from the analysis as they were not sexually mature. Tail length (TL) also was excluded from the analysis as several individuals showed scars indicative of caudal autotomy and regeneration.

		Character								
Specimen #	Sex	SVL	TL	AGD	HLL	HL	HB	SL	ED	TD
CMNH 3652	f	59.4	76.5	31.4	29.5	12.3	7.8	3.7	2.3	1.3
CMNH 3653	f	67.1	75.7	35.0	21.9	9.2	12.9	8.9	2.8	1.7
CMNH 3654	?	31.3	44.1	14.8	12.3	8.1	5.3	2.1	1.8	1.2
CMNH 3655	m	64.9	90.8[1]	31.3	24.3	14.4	9.8	4.7	3.1	2.0
USNM 337768	m	63.4	56.4[1]	31.8	24.3	13.0	8.7	4.0	3.1	1.5
CMNH 3657	m	66.7	100.0	34.6	25.0	14.1	8.9	4.6	3.2	1.7
CMNH 3658	f	51.2	33.5[1]	27.3	20.8	11.1	7.4	3.2	2.2	1.2
CMNH 2359	m	62.8	77.7	32.9	24.1	13.4	9.3	4.3	2.5	1.5
PNM 2300	m	56.6	70.8	27.9	22.9	12.0	7.6	4.6	1.7	1.3
PNM 2301	f	46.6	66.4	22.1	16.9	10.2	6.9	3.3	1.6	1.2
PNM 2302	m	62.7	91.6	33.3	23.5	13.1	9.1	4.6	3.1	1.5
PNM 2303	m	48.0	49.1[1]	21.8	20.3	10.8	6.5	3.7	2.6	1.1
PNM 2304	f	55.8	69.8	28.6	20.3	11.8	7.4	4.1	2.5	1.4
PNM 2305	m	56.5	80.4	29.8	22.9	12.5	8.2	4.5	2.8	1.5
PNM 2306	m	59.1	61.8[1]	30.3	22.4	12.7	8.2	4.1	2.6	1.3
PNM 2307	f	50.0	62.4	26.3	18.1	11.2	7.3	3.8	2.4	1.2
CAS 61183*	m	43.0	—	20.9	17.1	11.5	6.5	3.9	3.3	2.4
$\bar{X}$		58.9	—	30.2	22.3	12.5	8.2	4.2	2.7	1.5
SD		6.1	—	3.6	2.0	1.1	0.9	0.4	0.3	0.2
Range		19.2	—	13.7	7.0	3.6	3.3	1.5	0.9	0.9
n		14	—	14	14	14	14	14	14	14
W		N	—	N	N	N	N	N	N	N
g_1		−0.39	—	−0.83	−0.60	−0.05	−0.05	−0.67	−0.09	−0.66
g_2		−0.91	—	−0.86	−0.02	−0.66	−0.81	−0.07	−1.21	−0.42

[1] Tail recently autotomized or showing scars of caudal autotomy and subsequent regeneration.
* Holotype.

= 19–21—19–21; *n* = 16—16. Holotype with 5—5 first finger lamellae and ours have 5—5 (five specimens), 6—6 (7) or 7—7 (4); $\bar{X}$ = 6.4—6.4 ± 2.3—2.3 *SD*; range = 6–7—5–7; *n* = 16—16. Preanal scales strongly enlarged.

Body size.—Table 1 contains the morphological measurements taken from all known specimens of *S. beyeri*. Body size proportions of holotype and our new series are discussed below.

Coloration.—Color plates (Fig. 4) contain lateral views of male PNM 2302 in life. Dorsal surfaces dark umber to lavender brown. A mid-vertebral line of very dark brown to black spots variably obvious; vertebral spots (or line) at midbody usually encompassing one scale only, but occasionally two or three scale rows; spot series (or line) fading caudally on some specimens. Very dark brown to black series of irregular blotches laterally, usually forming a solid band, strongest at the pre-nuchal region, next strongest above hind limbs at pectoral girdle; band extending anteriorly through tympanum to rostral scale and caudally to thickest portions of tail base (⅓ total tail length). Dorsally, lateral band bordered by a thin golden yellow edge; ventrally, golden yellow edge becoming solid yellow on caudal por-

Fig. 4. *Sphenomorphus beyeri* in life before preservation (PNM male 2302; SVL = 62.7 mm). Note presence of grey volcanic ash on substrate. Photographs by RMB, courtesy of CMNH.

tions of body. Laterally, axilla-groin region bright orange with round yellow markings arranged in spots. Distinctive black tip on tail of all complete specimens. Undersides of arms and legs bright golden yellow. Posterior regions of hind limbs with distinct yellow spots surrounded with brown borders fading into a lavender brown background. Ventral side of body from nuchal region to tail golden yellow with pinkish tan, light grey, or very light sky blue flecks on nuchal region, ventral side of head, torso, and tail base. Lavender brown series of spots arranged into irregular, disjunct stripes of four to eight scales in length and one scale in width on ventral side of neck. Chin pinkish tan or translucent. Labial scales lavender to purplish, each with white spot in center or on ventral border of scale.

In alcohol: coloration generally faded throughout; ventral yellow and lateral orange fading to dull pinkish tan; ventral nuchal region devoid of blue tones; purple on labials fading to lavender or brown.

Comparisons.—Table 2 compares *S. beyeri* with closely related, sympatric, and/or morphologically similar species of *Sphenomorphus.*

Discrepancies with Taylor's original description.—Taylor's (1922b) description of *S. beyeri* stated that the holotype exhibited separated prefrontals, as do many of ours (10 of 16). However, three of our series have prefrontal scales in narrow to moderate contact and three others show the presence of an azygous interprefrontal (Fig. 3). In addition, Taylor (1922b) counted 40 scales at midbody in the holotype but did not record paravertebrals. Brown & Alcala (1980) and Alcala (1986) confirmed his midbody scale counts, and reported also that there were 94 paravertebral scales in the holotype. Our examination of the holotype confirms both of these reports, which fall within the range of variation for the new series (88–96; Table 2). Taylor (1922b) counted 17 lamellae under the holotype's longest (=fourth, rear) toe, but Brown & Alcala (1980) and Alcala (1986) reported that the holotype had 19 fourth toe lamellae. Our examination of the holotype confirms that the specimen has 19—19 subdigital lamellae under the fourth toe. Taylor (1922b) reported a SL/HL ratio for the holotype of 0.34; calculations for our series are remarkably close ($\bar{X} = 0.32$, range = 0.25–0.37; $n = 16$). Taylor (1922b) reported that the SL/HB ratio was 0.60 for the holotype; our series averaged 0.49 (range = 0.38–0.57; $n = 16$). Taylor's specimen had a HB/HL ratio of 0.57, and ours average 0.66 (range = 0.60–0.69; $n = 16$). Taylor reported a HB/SVL ratio of 0.15; our specimens average 0.14 (range = 0.13–0.17; $n = 16$). The holotype also had an ED/SL ratio of 0.50, but the eyes on our specimens seemed somewhat smaller on average ($\bar{X} = 0.37$; range 0.30–0.43; $n = 16$). Disparities in these calculated ratios may reflect the small sample size ($n = 1$) available to Taylor; the distinctive black tip on the tails of all complete specimens undoubtedly would not have been missed by Taylor had he been able to recover the portion of the holotype's tail which was autotomized and lost in capture.

Remarks.—Two of the Zambales specimens were gravid females (CMNH 3652 and 3653), each containing two yellowish, thickly-shelled, oviductal eggs, the texture of which suggest oviparity. One of our specimens appears to be recently hatched (CMNH 3654). It is well within the range of morphological variation described here for *S. beyeri* except that it has unfused frontoparietals. As stated above (site descriptions), both areas surveyed in this study contained ash deposits from the June 1991 eruption of Mt. Pinatubo. This rendered the forest floor, vegetation, and much of the remaining habitat very dry (Fig. 2). Where water might be expected to collect (i.e., in *Pandanus* axils or other depressions in rocks or vegetation), the ash rapidly absorbed water deposited by rain or dew. Taylor (1922b) mentioned that he found the holotype on a rock ledge on Mt. Banahao; none of our

Table 2.—Comparisons of scale counts and other diagnostic characters species of Philippine *Sphenomorphus* allied to, morphologically similar to, or sympatric with *S. beyeri*. Data are from specimens reported in this study, from specimens examined at USNM, and from pertinent literature account (Taylor 1922a, 1922b; Brown & Alcala 1980; Alcala 1986; Brown et al. 1995).

Species	Para-vertebrals	Scales around midbody	Fourth toe lamellae	SVL (mm) at maturity	Prefrontals	Fused fronto-parietals	Tympanum exposed?	Approximate known distribution
S. steerei	52–64	30–32 rarely 28	9–14	26.5–36.0	in contact	yes	yes	Throughout the Philippines
S. decipiens	57–66	32–38	14–18	31.1–45.0	broad contact	yes	yes	Luzon, Mindanao, Tablas
S. arborens	64–75	36–39	18–22	45.0–66.3	broad contact	no	yes	Negros, Masbate, Pan de Azucar, Panay
S. luzonense	66–71	28	9–12	38.5–48.0	separate or in contact	yes	no	N. Luzon
S. lawtoni	57–62	28	13–15	45.8	moderately in contact	yes	yes	N. Luzon
S. leucospilos	63–68	32	16–18	52.0–55.0	broad contact	yes	barely	Luzon
S. acutus	51–63	26–30	8–10	51.0–76.0	broad contact	yes	yes	Mindanao, Leyte, Samar Bohol, and Dinagat
S. variegatus	66–76	38–44	19–25	49.9–62.6	narrowly separated	no	yes	Mindanao, Sulu Arch., Leyte Bohol, Dinagat, Camiguin
S. cumungi	75–87	48–54	22–27	115–143.2	widely separated	no	yes	Mindanao, Bohol, Leyte, Luzon, Sibuyan, Dinaget, Mindoro
S. a. abdictus	63–74	36–42	21–25	81.3–91.0	usually separated	no	yes	Mindanao, Camiguin, Bohol
S. a. aquilonius[a]	62–73	34–38	20–25	55.4–95.5	usually separated	no	yes	Luzon, Polilio
S. c. coxi	62–72	32–38	19–26	53.0–85.0	usually separated	yes	yes	Mindanao, Camiguin, Leyte, Samar
S. c. divergens[b]	64–75	38–40	21–26	63.0–90.0	usually separated	yes	yes	Luzon, Marinduque, Mindoro
S. jagori	63–73	38–40	24–30	70.9–108.8	separate	no	yes	Throughout the Philippines
S. llanosi	67–70	38–42	20–24	63.9–90.0	separated or in contact	no	yes	Leyte, Samar
S. laterimaculatus	72	40	18	52.5	broad contact	yes	yes	S. Luzon
S. diwata	90–93	40–42	13–14	51.4–58.5	moderately in contact	no	yes	N. Mindanao
S. beyeri	88–96	38–42	19–21	46.61–67.12	usually separate	yes	yes	Midwestern and southern Luzon
S. knollmanae[c]	73–83	34–39	17–20	47.5–51.0	separate or in contact	yes	yes	S. Luzon

specimens were collected anywhere near rocks or outcroppings in the Zambales but, instead, from inside moist rotten logs. Only two specimens were caught in our extensive pitfall trap system, suggesting either low levels of activity or semi-fossorial existence. However, due to the disturbed nature of the forest on Mt. High Peak, it is impossible to establish the true microhabitat of *S. beyeri*. The apparent semi-fossorial nature of this species in the Zambales could have been due to animals retreating from the aridity of the immediate area which was blanketed by Mt. Pinatubo's ash.

At present, *S. beyeri* is known to exhibit an allopatric insular montane distribution. However, little biogeographical information can be inferred from this fact alone due to lack of reliable survey data for southern Luzon, specifically the areas between the two localities discussed here. While the two mountain ranges included in this species' locality records are located on separate geologic components of Luzon, adequate habitat connecting these insular regions probably existed during the last glaciation (Rutland 1968; Hashimoto 1981a, 1981b; Auffenberg 1988). Mountains like Mt. Makiling and Mt. Arayat may support undocumented populations of *S. beyeri* as suggested by their intermediate placement between the two known localities (Mt. High Peak and Mt. Banahao). Studies of poorly known high elevation montane environments (e.g., Brown & Alcala 1961b, Custudio 1986, Auffenberg & Auffenberg 1988) are needed in such areas in and between these two disjunct localities to ascertain the true distribution of *S. beyeri* as well as other relict species. While elevational species succession of scincid lizards (Custudio 1986) and small mammals (McCoy & Connor 1980, Rapoport 1982, Rickart et al. 1991, Ruedas et al. 1994) has recently been documented in some areas of the Philippines, little is known about the potential effects of elevational gradients on lizard species stratification, diversity, and endemism in the Philippine archipelago. Our unpublished survey data suggest that species diversity is inversely proportional to elevation, but that endemism is positively correlated with elevation at least on the islands of Luzon, Panay, Mindanao, and Mindoro. The latter topic is subject of another work in progress (Ferner, pers. comm.).

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[a] Differs from *S. a. abdictus* by the presence of four (as opposed to five) supraoculars.
[b] Differs from *S. c. coxi* by the presence of four (as opposed to five) supraoculars and coloration.
[c] New species (Brown et al. 1995, this issue).

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Literature Cited

Alcala, A. C. 1986. Guide to Philippine flora and fauna. Vol. X, Amphibians and reptiles. Natural Resource Management Center Ministry of Natural Resources and University of the Philippines, xv + 195 pp.

Auffenberg, W. G. 1988. Gray's monitor lizard. University of Florida Press, Gainesville, iv + 419 pp.

———, & T. Auffenberg. 1988. Resource partitioning in a community of Philippine skinks (Suaria: Scincidae).—Bulletin of the Florida State Museum, Biological Sciences 32(2):150–219.

Brown, R. M., J. W. Ferner, & Luis A. Ruedas. 1995. A new species of lygosomine lizard (Reptilia: Lacertilia: Scincidae; *Sphenomorphus*) from Mt. Isarog, Luzon Island, Philippines.—Proceedings of the Biological Society of Washington 108:18–25.

Brown, W. C., & A. C. Alcala. 1956. A review of the Philippine lizards of the genus *Lygosoma* (*Leiolopisma*).—Occasional Papers of the Natural History Museum, Stanford University 3:1–10.

———, & ———. 1961a. A new sphenomorphid lizard from Palawan Island, Philippines.—Occasional Papers of the California Academy of Science 32:1–4.

———, & ———. 1961b. Populations of amphibians and reptiles in submontane and montane forests of Cuernos de Negros, Philippine Islands.—Ecology 42(4):628–636.

———, & ———. 1970. The zoogeography of the herpetofauna of the Philippine islands, a fringing archipelago.—Proceedings of the California Academy of Science, fourth series 4(38):105–130.

———, & ———. 1980. Philippine lizards of the family Scincidae.—Silliman University Natural Science Monograph Series 2. 264 pp.

———, & D. S. Rabor. 1967. A new sphenomorphid lizard (Scincidae) from the Philippine islands.—Proceedings of the Biological Society of Washington 80:69–72.

Bureau of Mines, Philippines, in coordination with the Board of Technical Surveys and Maps. 1963. Geological map of the Philippines, edition 1. Single sheet map.

Custudio, C. C. 1986. Altitudinal distribution of lizards of the Scincidae in Mt. Makiling, Laguna.—Sylvatropical Philippine Forest Research Journal 11(3, 4):181–202.

Dickerson, R. E. 1924. Tertiary paleogeography of the Philippines.—Philippine Journal of Science 25(1):10–55.

Greer, A. E. 1979. A phylogenetic subdivision of Australian skinks.—Records of the Australian Museum 32:339–371.

———, & F. Parker. 1974. The *faciatus* species group of *Sphenomorphus* (Lacertilia: Scincidae): notes on eight previously described species and descriptions of three new species.—Proceedings of the Papua New Guinea Science Society 25:31–64.

Hashimoto, W. 1981a. Geologic development of the Philippines. Pp. 83–170 *in* T. Kobiyashi, R. Toriyama, & W. Hashimoto, eds., Geology and paleontology of Southeast Asia, CCXVII, Vol. 22.

———. 1981b. Supplementary notes on the geologic development of the Philippines. Pp. 171–190 *in* T. Kobiyashi, R. Toriyama, & W. Hashimoto, eds., Geology and paleontology of Southeast Asia, CCXVIII, Vol. 22.

McCoy, E. D., & E. F. Connor. 1980. Latitudinal gradients in the species diversity of North American mammals.—Evolution 34:193–203.

Myers, W. C., & M. A. Donnelly. 1991. The lizard genus *Sphenomorphus* (Scincidae) in Panama, with a description of a new species.—American Museum Novitates 3027:1–12.

Rapoport, E. 1982. Areography: geographical strategies of species. Pergamon Press, New York, xvi + 269 pp.

Rickart E. A., L. R. Heaney, & R. C. Utzurrum. 1991. Distribution and ecology of small mammals along an elevation transect in Southeast Luzon, Philippines.—Journal of Mammalogy 72:458–469.

Ruedas, L. A., J. R. Demboski, & R. V. Sison. 1994. Morphological and ecological variation in *Otopteropus cartilagonodus* Kock, 1969 (Mammalia: Chiroptera: Pteropodidae) from Luzon, Philippines.—Proceedings of the Biological Society of Washington 107:1–16.

Rutland, R. W. 1968. A tectonic study of part of the Philippine Fault Zone.—Quarterly Journal of the Geological Society of London 123(4):293–325.

SAS Institute Inc. 1988a. SAS/STAT user's guide, release 6.03 edition. SAS Institute Inc., Cary, North Carolina, 1028 pp.

———. 1988b. SAS procedures guide, release 6.03 edition. SAS Institute Inc. Cary, North Carolina, 441 pp.

Sokal, R. R., & F. J. Rohlf. 1981. Biometry, second edition. W. H. Freeman and Co., New York, xviii + 859 pp.

Taylor, E. H. 1922a. The lizards of the Philippine islands.—Monograph of the Bureau of Science, Manila, 17:1–115.

———. 1922b. Additions to the herpetological fauna of the Philippine Islands, II.—Philippine Journal of Science 21(3):253–303.

UNESCO/ECAFE. 1971. Geologic map of Southeast Asia. United Nations Publication, No. 69-30632.

Whitmore, T. C. 1984. Tropical rain forests of the Far East. Clarendon Press, Oxford, England. xvi + 718 pp.